King Fahd University of Petroleum and Minerals
College of Computer Sciences and Engineering
Department of Computer Engineering

COE 540 – Computer Networks (T082)

Homework # 02 (*due date: Tuesday 19/05/2009 during class period*)

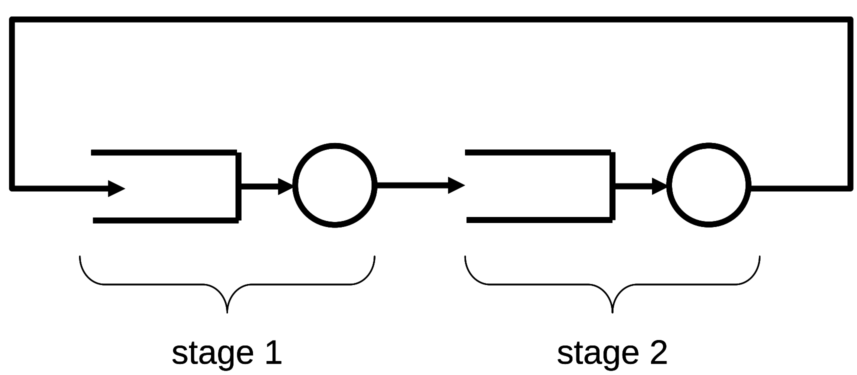
Problem # 1 (50 points): Data in the form of fixed-length packets arrive in slots on the TWO input lines of a multiplexer. A slot contains a packet with probability p, independent of the arrivals during other slots or on the other line. The multiplexer transmits one packet per time slot and has the capacity to store THREE packets only. If no room for a packet is found, the packet is dropped.

1. COMPUTE the probability of j (for all possible j values) packets arriving on the TWO input lines during any given time slot.
2. DRAW the state transition diagram and SPECIFY the transition matrix **P** – The state is taken to be the number of packets in the multiplexer.
3. If p is equal to 0.3, what is the probability that the MUX will contain 2 packets after 10 time slot (i.e. at the start of the 11^{th} time slot)? Assume that we start with an empty MUX. (Hint: *Use Matlab or any other programming language to simplify the computation process*).

Problem # 2 (20 points): Consider a "cyclic queue" in which M customers circulate around through two queueing facilities as shown below. Both servers are of the exponential type with rates µ1 and µ2, respectively. Let p_k be defined as the probability of k customers in stage 1 and M-k in stage 2.

a) Draw the state-transition-rate diagram.

b) Write down the relationship among $\{p_k\}$ (i.e. global balance equations).



Problem # 3 (30 points): Assume a small enterprise is installing a PBX telephony system with c outgoing phone lines connecting the enterprise with the PSTN. The population and calling behavior of the enterprise employees are such that calls are generated according to a Poisson arrival process with a rate of 3 calls every 5 minutes. The mean call duration is 4 minutes. Assume that calls arriving to the PBX while the c outgoing lines are busy are blocked. Let c = 5. Compute the following:

(1) The offered load from the enterprise.

(2) The probability that a call originating from the enterprise is blocked.

(3) If it is desired to provide a quality of service (QoS) equal to 0.5% blocking for originating calls, what would be the minimum size (i.e. value of c) for the PBX achieving this QoS?